Does social media democratize science? The role of gender homophily in scientific success

Orsolya Vásárhelyi*
Department of Network and Data Science, Central European University
Vasarhelyi_Orsolya@phd.ceu.edu

Igor Zakhlebin†
Department of Communication Studies, Northwestern University

Emőke-Ágnes Horvát‡
Department of Communication Studies, Northwestern University

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1 INTRODUCTION

Despite improvements, female scientists are still facing more challenges than their male colleagues: they earn less [13], have access to less funding [9], are less likely to become full professors [10], their work receive less citations [8], and they benefit less from co-authorship [12]. These disparities persist, despite evidence that female members increase the overall intelligence of teams[3] and gender heterogeneous scientific teams are more creative and produce higher quality science [5]. This puzzle calls for more investigation into the gender aspects of scientific success.

Traditional metrics for quantifying academic performance like impact factor and h-index have often been contested [2, 4, 7]. As one response to this debate, Altmetric was created in 2010 to complement traditional citation based metrics with data taken from the Web. Social media based bibliometrics have been heralded as metrics which lead to a more democratic science by quantifying the viral influence of new scientific results online [1].

A higher Altmetric score has been shown to affect the number of citations [14], but little is known about how potential social biases manifested online might effect women. Research shows that 70% of people, regardless of their gender, associate science more with men than with women. In the world of social media, self-promotion is a key factor to success, but typically avoided by women [11].

In this poster we argue that teams with male majority utilize social media shares better. However, if papers written by diverse and female majority teams become highly successful in social media, they can overcome institutionalized inequalities and archive higher long-term scientific success than male majority teams.

2 DATA

Our data is coming from three sources connected by article DOIs: 1.) Data from **Altmetric** contains mentions in public social media posts, news coverage, citations on Wikipedia, public policy papers and research blogs between 2012 and 2017. 2.) A compilation of collaborations from the **Open Academic Graph (OAG)**, which contains publication history of authors that appeared in the Altmetric database in the year 2012: in total 241,386 articles. 3.) Citation numbers and scientific field for each publication from the year 2012 from the **Web of Science (WOS)**. To calculate gender diversity, we adopt a gender inference method based on authors' first names in the OAG dataset [6]. Gender inference yields 48% men, 29% women, and 23% unknowns among the 1.4 million unique authors. Altmetric also contains the source of social media mentions. In the case of Twitter, Facebook and Google+, the source is more likely to be a person than an organization or a journal. Therefore, we also parse all Altmetric users' names from these sources, and infer their gender, resulting in 23% women , 35% men, and 43% unknowns.

3 RESULTS

First, we calculate the ratio of men and women for each publication; then identify whether the team has male or female majority, or is gender diverse. Results show that teams with male majority have the most total social media shares on average. If we control for the gender of the authors on social media, the underlying gender homophily becomes clear: men (compared to women) are significantly more often shared by other men, and women (compared to men) are significantly more often shared by women.

The ratio of women depends on the academic field under consideration, and we assume that this is one of the reasons behind the observed strong gender homophily. Therefore, for each field we calculate a field-dependent gender majority: a paper has a certain gender majority if the ratio of the given gender is higher than the average ratio in the particular scientific field plus a standard deviation. After controlling for field-dependent majority, the previously seen gender homophily disappears, and in every case papers with field-dependent *male majority have the most shares*, regardless of the gender of social media users.

Finally, we grouped papers by social media popularity and compare the number of citations 5 years after publication. *We found that very popular papers (top 10 percent by the number of shares) written by female majority and diverse teams benefit more from social media shares* than papers written by male majority teams.

REFERENCES

[1] 2019. Altmetrics Manifesto. (May 2019). http://altmetrics.org/manifesto/
[2] Cameron Barnes. 2017. The h-index Debate: An Introduction for Librarians. *The Journal of Academic Librarianship* 43, 6 (November 2017), 487-494. https://doi.org/10.1016/j.acalib.2017.08.013
[3] Julia B. Bear and Anita Williams Wolley. 2011. The role of gender in team collaboration and performance. *Interdisciplinary Science Reviews* 36 (2011), 146âĂŞ53. https://doi.org/10.1179/030801811X13013181961473
[4] L. Bornmann and HD Daniel. 2005. Does the h-index for ranking of scientists really work? *Scientometrics* 65, 391 (2005). https://doi.org/doi.org/10.1007/s11192-005-0281-4
[5] :G Campbell, S Mehtani, ME Dozier, and J Rinehart. 2013. Gender-Heterogeneous Working Groups Produce Higher Quality Science. *PLoS ONE* 8 (10) (2013). https://doi.org/10.1371/journal.pone.0079147

*Conducted data collection on WOS, parsed names and inferred gender, ran analysis.
†Parsed data from Altmetrics and OAG.
‡Supervisor

[6] Denae Ford, Alisse Harkins, and Chris Parnin. 2017. Someone like me: How does peer parity influence participation of women on stack overflow? *2017 IEEE Symposium on Visual Languages and Human-Centric Computing* (2017). https://doi.org/10.1109/VLHCC.2017.8103473
[7] Charles W. Fox and C. E. Timothy Paine. 2019. Gender differences in peer review outcomes and manuscript impact at six journals of ecology and evolution. *Ecology and Evolution* 9 (March 2019), 3599-3619. https://doi.org/10.1002/ece3.4993
[8] Vincent Lariviere, Chaoqun Ni, Yves Gingras, Blaise Cronin, and Cassidy R. Sugimoto. 2013. Bibliometrics: Global gender disparities in science. *Nature* 504 (December 2013), 211âĂŞ213. https://doi.org/10.1038/504211a
[9] T. J. Ley and B. H Hamilton. 2008. The Gender Gap in NIH Grant Applications. *Science* 422 (December 2008), 1472-1474. https://doi.org/10.1126/science.1165878
[10] C. A. MossRacusin, J. F. Dovidio, Brescoll, Graham V. L., and M. J. Handelsman. 2012. Science facultyâĂŹs subtle gender biases favor male students. *PNAS* 109, 49 (December 2012), 16474-16479. https://doi.org/10.1073/pnas.1211286109
[11] Corinne A. MossRacusin and Laurie Rudman. 2010. Disruptions in Women's Self-Promotion: The Backlash Avoidance Model. *Article in Psychology of Women Quarterly* 34, 2 (May 2010), 186-202. https://doi.org/10.1111/j.1471-6402.2010.01561.x
[12] Heather Sarson. 2017. Recognition for Group Work: Gender Differences in Academia. *American Economic Review* 107, 5 (May 2017). https://doi.org/10.1257/aer.p20171126
[13] H. Shen. 2013. Inequality quantified: Mind the gender gap. *Nature* 495 (March 2013), 22-25. https://doi.org/10.1038/495022a
[14] Mike Thelwall, Stefanie Haustein, Vincent Larivier, and Cassidy R. Sugimoto. 2013. Do Altmetrics Work? Twitter and Ten Other Social Web Services. *PLoS ONE* 8, 5 (2013). https://doi.org/doi:10.1371/journal.pone.0064841